

Mineral Nutrition

Plants make their own food from minerals, air, and sunlight.

Animals consume organic food made by other living organisms.



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What do plants need to grow?

- air
- water
- sunlight
- _____ ?

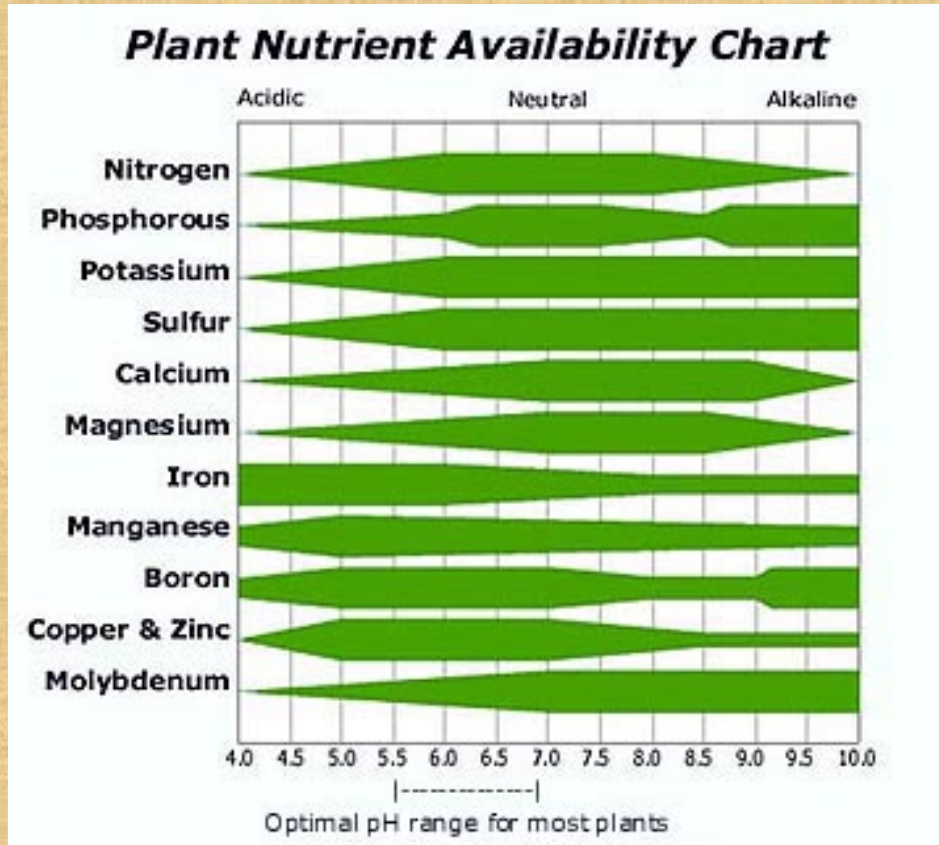


How can plants grow without soil?

- Plant nutrients are often called “fertilizer.”
- Fertilizers carry a three-number code that tells the concentration of the macronutrients: N, P, and K (chemical symbols for Nitrogen, Phosphorus, Potassium).
- Other elements needed by plants are called micro-nutrients (B, Cu, Mg, Mn, Mo, S, Zn) .
- These elements are present in the soil as minerals.
- Tower Tonic supplies the minerals that roots would otherwise absorb from the soil.
- Watch this video on how nutrients help the plants grow in the Tower Garden. [Vertical Aeroponic Technology](#)



pH affects the ability of plants to absorb minerals



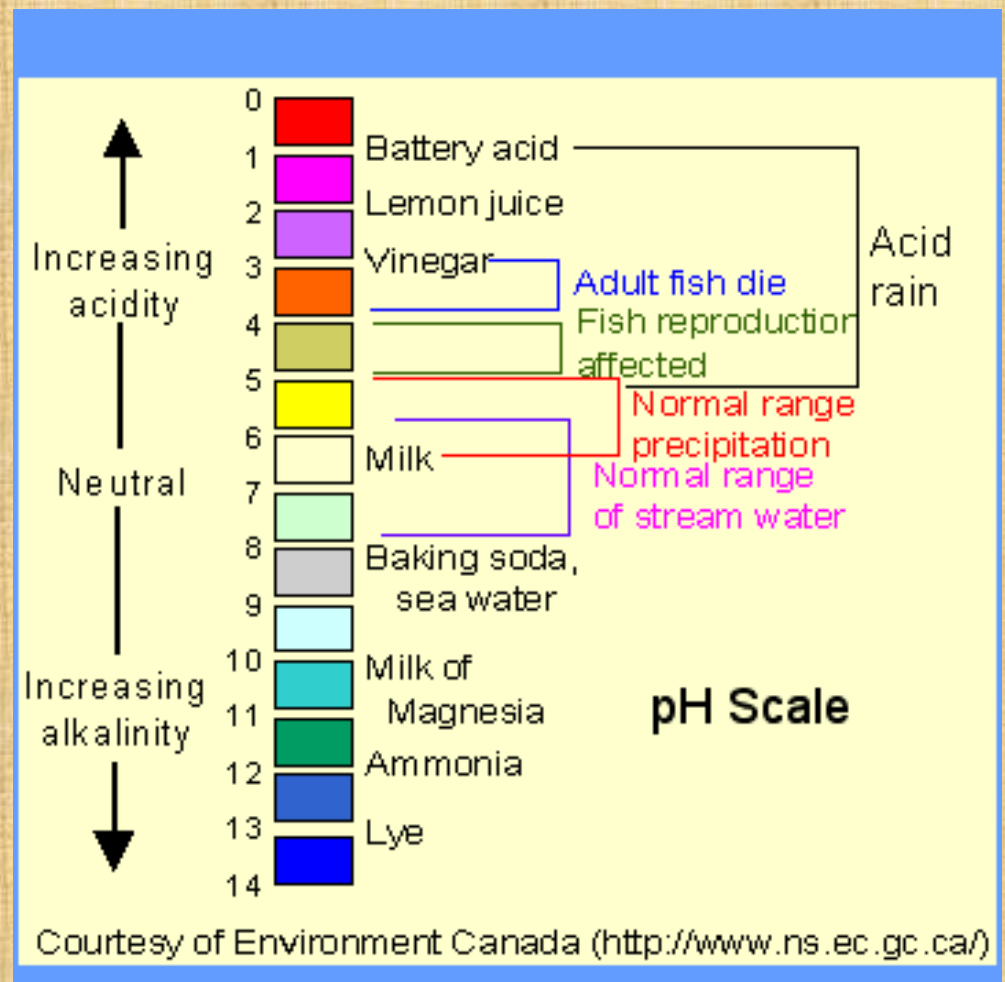
- pH indicates the acidity or alkalinity of a solution.
- Pure water has pH=7, which is considered “neutral.”
- Most plants grow best in pH that is slightly acidic.

What number might that be?

Primer about pH

- pH indicates how acidic or alkaline (basic) a solution is using a scale from 1 to 14; water is pH 7 (neutral).
- Water can ionize, which means it breaks into charged ions, like this:
 $2 \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$
- An excess of OH^- is called alkaline or basic, $\text{pH} > 7$.
- An excess of H_3O^+ is called acidic, $\text{pH} < 7$.

Why would pure water be considered “neutral pH”?



Two kinds of neutrality

- Having pH neutrality means equal numbers of H_3O^+ and OH^- .
 - Electrical neutrality is having equal numbers of + and – charges.
 - Some negative ions and their charges: nitrate (**NO_3^-**) phosphate (**PO_4^{--}**)
sulfate (**SO_4^{--}**)
 - Some positive ions and their charges: **K^+ , Mg^{++} , Mn^{++} , Ca^{++}**
1. Explain how to make calcium nitrate so it is electrically neutral.
 2. Explain how to make potassium sulfate so it is electrically neutral.

Plant roots maintain electric neutrality.

This can affect the pH in the solution around the roots.

- Roots take in nutrients as positive or negative ions.
- When roots take in nitrate, they expel OH^- to regain electric neutrality.
- When roots take in Ca^{++} , they regain neutrality by expelling 2H^+
- Tower Tonic is formulated so roots take in roughly even positive and negative nutrients. This way, the roots maintain electric neutrality and don't change the pH in the solution.



Nutrients in Tower Tonic A

| Element % | Mineral Forms | Major function in Plant | Major function in Human | References |
|-----------------|---|------------------------------|-------------------------|------------|
| Nitrogen (N) 2% | Ca ⁺⁺ and 2 NO ₃ ⁻ | proteins, DNA, RNA contain N | | |
| Calcium (Ca) 1% | Calcium nitrate | Plant cell wall | | |
| Iron (Fe) 0.5% | FeNa EDTA Chelated iron | Energy in cells | | |

- The nutrients highlighted in yellow, contain a balance of positive and negative parts.
- Explain how this helps maintain a balanced pH in the solution around the roots.

Nutrition in plants and in animals



- Fill in the chart on your worksheet to explore how plant nutrients are used in humans.
- How is Tower Tonic similar to and different from human food?



Dietary recommendations and human nutrition

- *Dietary Guidelines for Americans* are issued by the Department of Agriculture (USDA) and the Department of Health and Human Services (HHS).
- Recently, the Food Pyramid was replaced by Choose My Plate.
- Compare and contrast the two concepts for helping people understand good nutrition.

